

## Pollen Morphology of the Genus *Hylodesmum* (Leguminosae: Papilionoideae tribe Desmodieae)

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Pollen grains of nine of the 14 species of the genus *Hylodesmum* were examined by scanning and transmission electron microscopy mostly for the first time. They share commonly characteristics in the structure of exine, i. e., thick endexine, densely columellate infratextum and discontinuous foot layer. Most of the species have tricolporate, prolate spheroidal to subprolate and fine-rugulate to microreticulate pollen grains. However, pollen grains of *H. oldhamii* are deviated in the sculpture and structure of the exine from the common pattern and those of *H. repandum* in the pollen type and shape.

**Key words:** *Desmodium*, exine sculpture, fine structure, *Hylodesmum*, pollen morphology.

The genus *Hylodesmum* comprises 14 species of which 10 are distributed in India through China to Japan and the Kuriles (Etrof Island), three in east North America to Mexico, and one in Asia extending to Africa (Ohashi and Mill 2000, Ohashi 2005). It had been recognized as section or subgenus *Podocarpium* in *Desmodium* (Bentham 1852, Ohashi 1973), but was later separated from *Desmodium* in various gross morphological characters, germination pattern, herbaceous habit and ecological preference for forest habitats (Ohashi and Mill 2000). The results of cpDNA studies of *Desmodium* subgen. *Podocarpium* suggested that the subgenus is monophyletic (Kajita and Ohashi 1994).

Pollen morphology of the species of *Hylodesmum* was first examined by Ikuse (1956) as a member of *Desmodium*. She reported that pollen grains of *Desmodium oldhamii* (= *H. oldhamii*) and *D. racemosum* (= *H. podocarpum* subsp. *oxyphyllum* var.

*japonicum*) are different from each other in the size of reticulate sculpture on the exine. Ohashi (1973) described pollen grains of the following six species of *Hylodesmum* which were regarded as members of subgenus *Podocarpium* in *Desmodium*. They are *D. duclouxii* from China, *D. glutinosum* from U.S.A., *D. repandum* from Asia and Africa, *D. oldhamii* from Japan, *D. laxum* including subsp. *laxum*, subsp. *laterale* and subsp. *leptopus* from Japan and Taiwan, and *D. podocarpum* including subsp. *podocarpum*, subsp. *fallax* and subsp. *oxyphyllum* from Japan and China. They were examined by light microscopy (LM) except the colpus of *D. podocarpum* subsp. *podocarpum* which was shown in SEM micrograph for the first time as pollen grains of *Desmodium* (plate 56 in Ohashi 1973). In the subgenus Ohashi (1973) distinguished three *D. repandum*-type, *D. oldhamii*-type and *D. podocarpum*-type. Chen and Huang (1993) observed

pollen grains of *H. laterale* and *H. leptopus* as *D. laxum* subsp. *laterale* and subsp. *leptopus* under scanning (SEM) and transmission (TEM) electron microscopy, and shows SEM micrographs of *H. leptopus*. In this study, pollen grains of *H. nudiflorum*, *H. pauciflorum* and *H. williamsii*, are examined for the first time and of five other species except *H. laxum*, *H. glutinosum*, *H. longipes*, *H. oldhamii*, *H. podocarpum* and *H. repandum*, are first observed by SEM and TEM.

The previous works have not fully demonstrated fine sculptures of the exine and have not shown structures of exine. These were at the limit of observation by LM. This paper provides revised descriptions based on SEM and TEM observations and micrographs of pollen grains of nine species of *Hylodesmum* for further systematic studies on the genus as well as the tribe Desmodieae.

### Materials and Methods

Pollen materials were obtained from herbarium specimens kept in the Tohoku University Herbarium, Botanical Garden, Tohoku University (TUS), Herbarium, University Museum, University of Tokyo (TI) and Herbarium of Kunming Institute of Botany, Academia Sinica (KUN).

For SEM observation, pollen grains were acetolysed following the standard method (Erdtman 1960) and dehydrated in an ethanol series. The samples were air dried and coated with gold palladium, and examined with a Hitachi S-4100 scanning electron microscope in the Biological Institute, Tohoku University in 1995 to 1998 (Ye and Ohashi 2002, 2005). The polar and equatorial lengths were measured on 20 grains in each sample. For TEM observation, acetolysed pollen grains were fixed with 2 % osmium tetroxide, embedded in Spurr low viscosity resin. After sectioning with the glass knife, the sections were stained with uranyl acetate and lead citrate, and examined with a Hitachi

H-8100 transmission electron microscope in the Biological Institute, Tohoku University in 1998 (Ye and Ohashi 2002, 2005).

### Terminology

Pollen terminology in our study generally follows Punt et al. (1994), but a term, infratectum (pl. infratecta), has been used such definition as the layer between the tectum and the foot layer (Ye and Ohashi 2002, 2005 and several papers by Ohashi 2003, etc.). It was defined by Punt et al. (1994) as "a general term for the layer beneath the tectum" (on page 32). This may mean that infratectum includes the layers below the tectum, but our infratectum does not include the nexine and intine. It is a synonym of interstitium as pointed out by Punt et al. (1994), that is "the layer of the exine situated between the nexine and the tectum" (on page 33). Infratectum is composed of columellae. A term, columellae layer, is, therefore, a synonym of the infratectum as defined by Punt et al. (1994).

### Pollen morphology of the species of *Hylodesmum*

#### 1. *Hylodesmum glutinosum* (Muhl. ex Willd.) H. Ohashi & R. R. Mill [Fig. 1]

Pollen grains tricolporate; medium to large in size, (31.9–)34.3(–38.1)  $\mu\text{m}$  in polar axis, (25.6–)28.1(–33.4)  $\mu\text{m}$  in equatorial diameter, P/E = (1.08–)1.23(–1.36), prolate spheroidal to prolate in shape, elliptic or rectangular-elliptic in equatorial view, almost circular or semi-angular in polar view. Colpi medium in size, 0.7–0.8 times the length of polar axis, narrow, ca. 2  $\mu\text{m}$  wide at equator, tapering to pointed ends, almost undifferentiated from mesocolpium along margin; colpus membrane with granules; endoaperture medium, 0.1–0.3 times the length of polar axis. Sexine tectate. Sculpture of mesocolpium finely rugulate.

Exine ca. 1.5  $\mu\text{m}$  thick in mesocolpium, sexine thicker than nexine; tectum

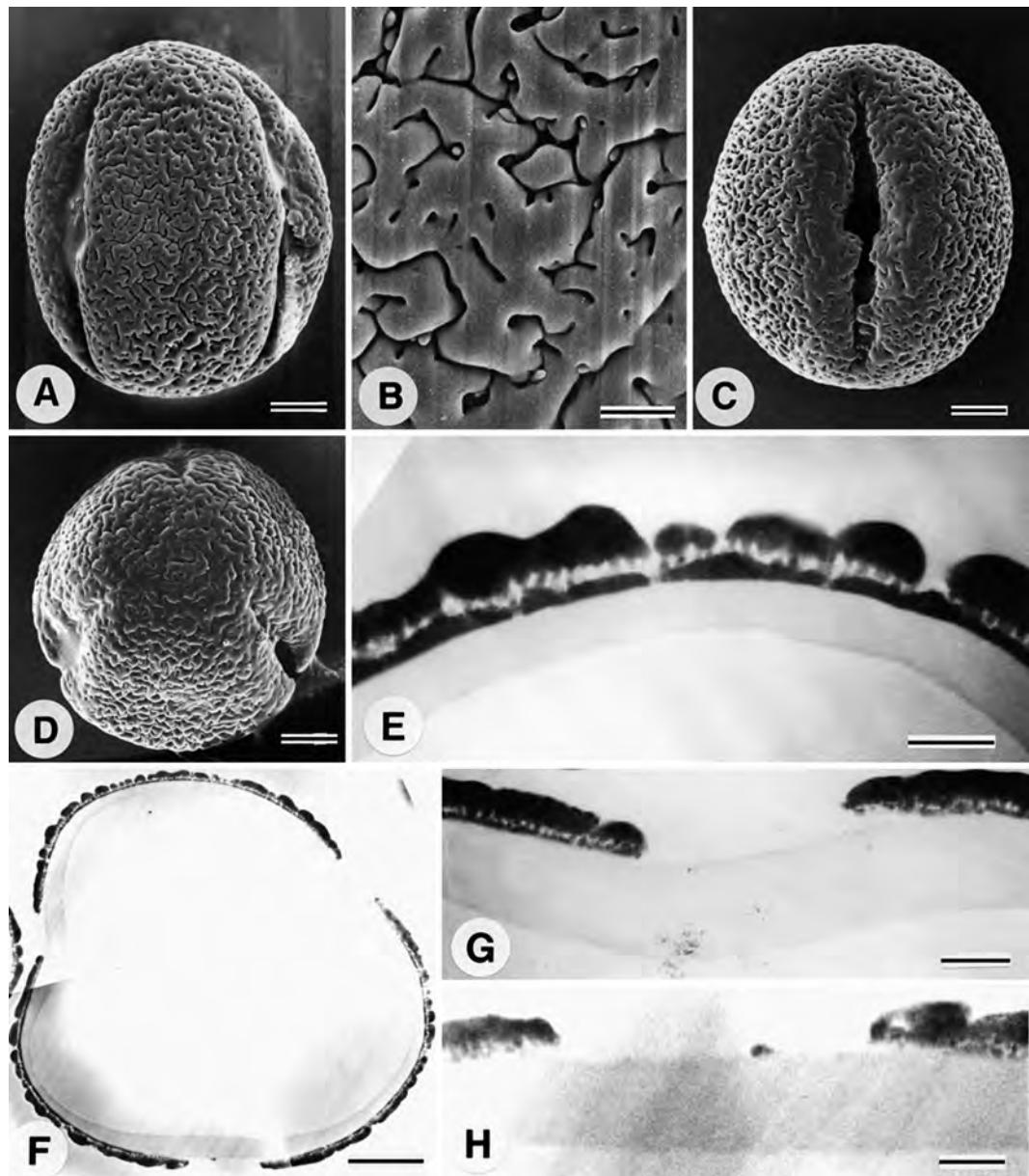


Fig. 1. Pollen of *Hylodesmum glutinosum* (Muhl. ex Willd.) H. Ohashi & R. R. Mill. A. Mesocolpium-centered equatorial view. B. Tectum at mesocolpium. C. Aperture-centered equatorial view. D. Polar view. E. Radial section across mesocolpium. F. Mostly radial section of whole grain. G-H. Section across aperture. Scale bar = 1  $\mu$ m.

discontinuous, ca. 1/3 times the thickness of exine; infratectum well defined, short, ca. 1/2 times the thickness of tectum; foot-layer irregular, as thick as infratectum; endexine

well developed, ca. 1/3 times the thickness of exine, gradually thickening toward the colpus.

Voucher specimens: U.S.A. Missouri. Jefferson Co.,

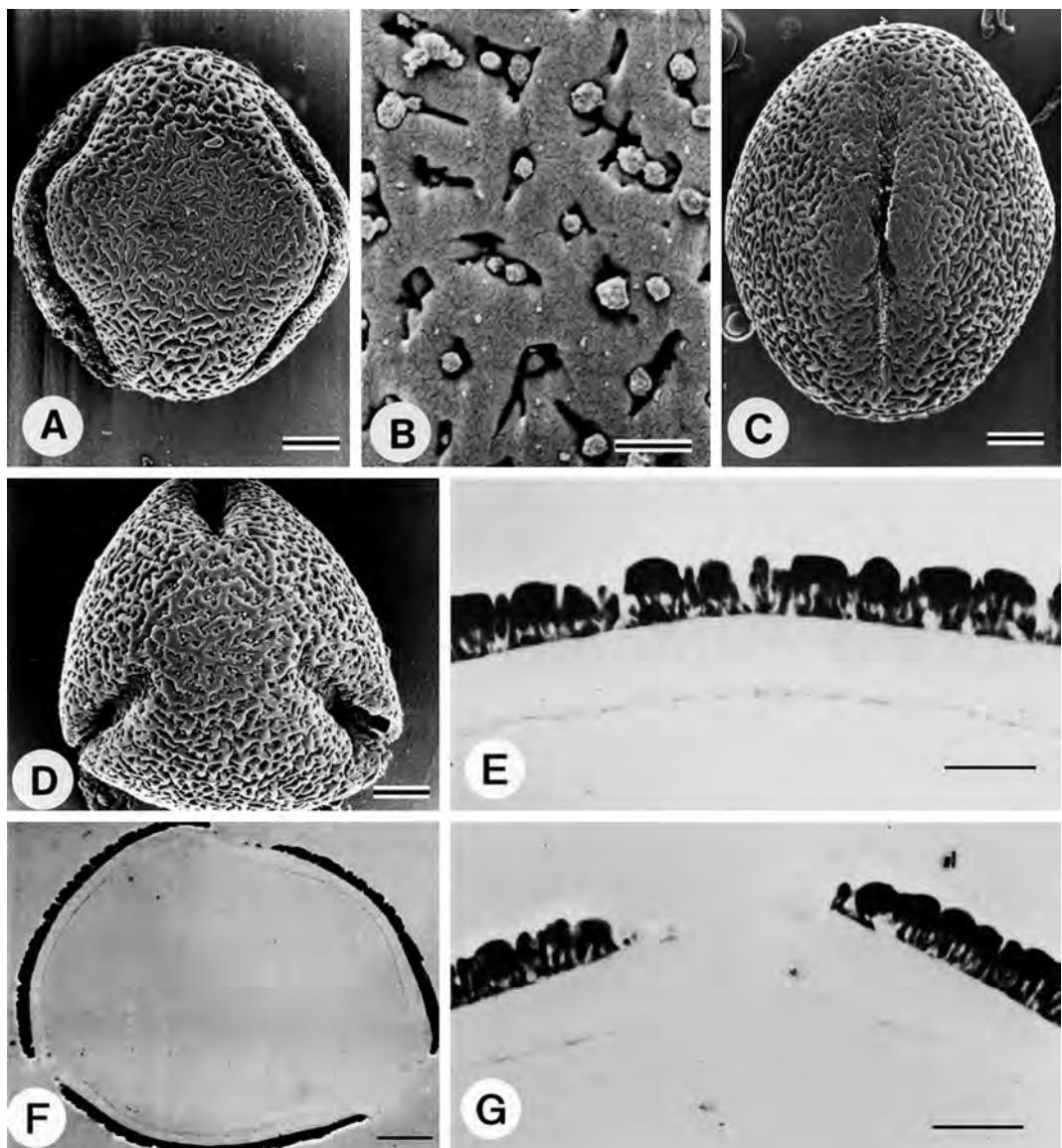


Fig. 2. Pollen of *Hylodesmum laxum* (DC.) H. Ohashi & R. R. Mill. A. Mesocolpium-centered equatorial view. B. Tectum at mesocolpium. C. Aperture-centered equatorial view. D. Polar view. E. Radial section across mesocolpium. F. Mostly radial section of whole grain. G. Section across aperture. Scale bar = 1  $\mu$ m.

Valley View Glades, about 4.5 miles northwest of Hillsboro, ca. 200 m alt. 19 Aug. 1995. T. Nemoto & J. Yokoyama 95819010 (TUS).

Note: Ohashi (1973) described sculpture of the exine of this species as microreticulate (as finely reticulate) or verrucate, but added

a remark that they were deviated from the typical pattern. These patterns are clarified in this study as fine rugulate.

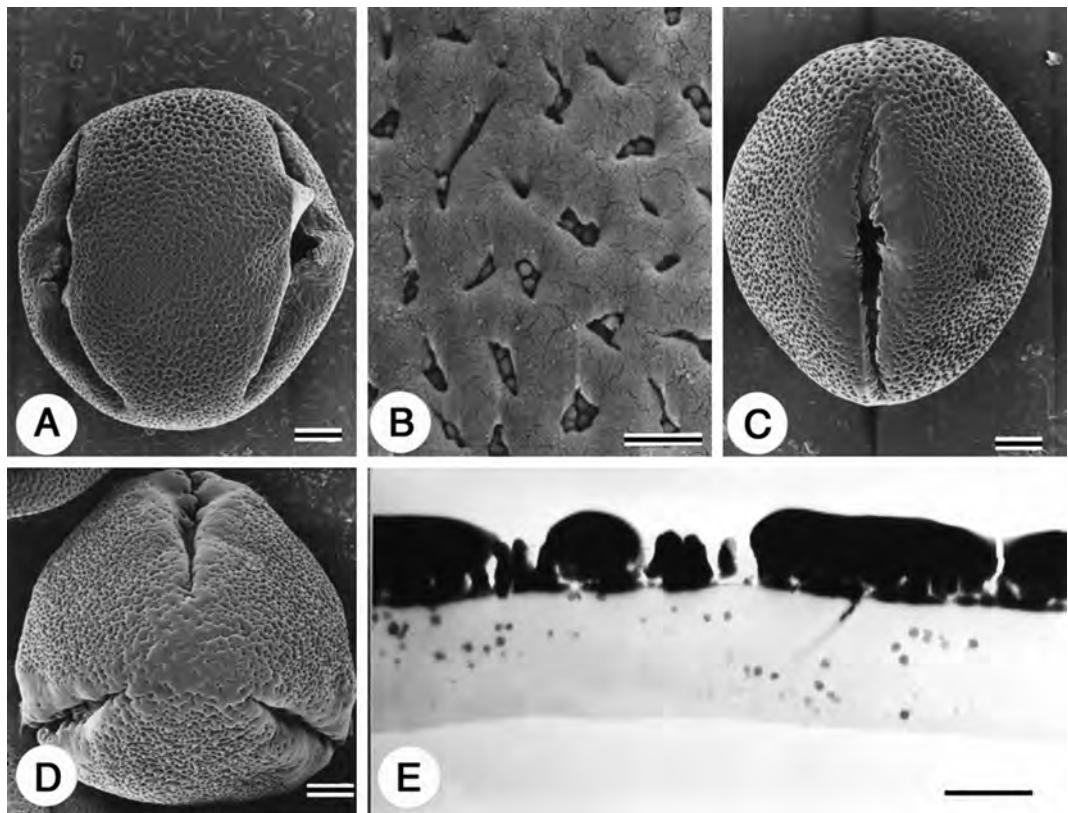


Fig. 3. Pollen of *Hylobesmum longipes* (Franch.) H. Ohashi & R. R. Mill. A. Mesocolpium-centered equatorial view. B. Tectum at mesocolpium. C. Aperture-centered equatorial view. D. Polar view. E. Radial section across mesocolpium. Scale bar = 1  $\mu$ m.

## 2. *Hylobesmum laxum* (DC.) H. Ohashi & R. R. Mill [Fig. 2]

Pollen grains tricolporate; medium in size, (30.0)–31.7(–34.4)  $\mu$ m in polar axis, (25.6)–28.7(–34.4)  $\mu$ m in equatorial diameter, P/E = (0.94)–1.11(–1.29), spheroidal or subprolate in shape, elliptic or rhombic in equatorial view, semi-angular in polar view. Colpi medium in size, 0.7–0.8 times the length of polar axis, very narrow, ca. 1  $\mu$ m wide at equator, tapering to rounded ends; almost tectate along margin; colpus membrane with fine granules; endoaperture medium, 0.1–0.3 times the length of polar axis. Sexine tectate. Sculpture of mesocolpium finely rugulate to microreticulate, lumina less than 1  $\mu$ m in diameter, with free tryphe.

Exine 1–1.5  $\mu$ m thick in mesocolpium; sexine thinner than nexine; tectum discontinuous, less than 1/4 times the thickness of exine; infratectum undefined, as thick as tectum; foot-layer very reduced, almost absent; endexine well developed, more than 1/2 times the thickness of exine.

Voucher specimen: Japan. Kyushu. Kagoshima Pref. Yakushima Island. Sep. 1909. T. Makino (TUS).

## 3. *Hylobesmum longipes* (Franch.) H. Ohashi & R. R. Mill (= *Desmodium duclouxii* Pampan.) [Fig. 3]

Pollen grains tricolporate; large in size, (40.6)–44.4(–47.2)  $\mu$ m in polar axis, (33.4)–39.0(–43.8)  $\mu$ m in equatorial diameter, P/E = (1.11)–1.21(–1.29), prolate spheroidal or

subprolate in shape, elliptic or rhombic in equatorial view, almost semiangular in polar view. Colpi medium in size, 0.7–0.8 times the length of polar axis, narrow, ca. 2  $\mu\text{m}$  wide at equator, tapering to pointed ends, completely tectate along margin; colpus membrane almost smooth, occasionally with fine granules; endoaperture medium in size, 0.1–0.3 times the length of polar axis. Sexine tectate. Sculpture of mesocolpium rugulate or microreticulate, lumina less than 1  $\mu\text{m}$  in diameter, with free columellae elements within the lumina.

Exine 2–2.5  $\mu\text{m}$  thick in mesocolpium; sexine thinner than nexine; tectum discontinuous, 1/3–1/4 times the thickness of exine; infratectum undefined, ca. 1/2 times the thickness of tectum; foot-layer reduced, discontinuous; endexine very well developed, more than 1  $\mu\text{m}$  thick.

Voucher specimen: China. Yunnan. D. D. Zhong 63-4035 (KUN).

Note: The sculpture of this species was described by Ohashi (1973) as reticulate with lumina 1–2  $\mu\text{m}$ , but the size is confirmed as less than 1  $\mu\text{m}$  in this study. The pattern is common with those of most of other species in the genus.

#### 4. *Hyloidesmum nudiflorum* (L.) H. Ohashi & R. R. Mill [Fig. 4]

Pollen grains tricolporate; medium in size, (28.1–)30.2(–33.1)  $\mu\text{m}$  in polar axis, (25.0–)27.3(–29.7)  $\mu\text{m}$  in equatorial diameter, P/E = (1.02–)1.11(–1.21), prolate spheroidal or subprolate in shape, elliptic in equatorial view, almost circular in polar view. Colpi indistinct, short to medium, 0.6–0.7 times the length of polar axis, broad, ca. 3  $\mu\text{m}$  wide at equator, tapering slightly to rounded ends, almost undifferentiated from mesocolpium along margin; colpus membrane with scattered granules; endoaperture medium, 0.1–0.3 times the length of polar axis. Sexine tectate. Sculpture of mesocolpium finely rugulate to microreticulate, lumina 0.5–1  $\mu\text{m}$

in diameter.

Exine ca. 1.5  $\mu\text{m}$  thick in mesocolpium; sexine thinner than nexine; tectum discontinuous, 1/4–1/5 times the thickness of exine; infratectum well defined, as thick as tectum; foot-layer irregular, discontinuous; endexine well developed, more than 1/2 times the thickness of exine, gradually thickening toward the colpus.

Voucher specimens: U.S.A. South Carolina. Oconee Co., Sumter National Forest, Moody Spring, along the Forest Service Road 709, west of State Hwy. 107, ca. 2200–2500 ft. alt. 7 Aug. 1995. H.Ohashi & al. 95807149 (TUS).

#### 5. *Hyloidesmum oldhamii* (Oliv.) H. Ohashi & R. R. Mill [Fig. 5]

Pollen grains tricolporate; medium in size, (27.5–)31.0(–33.5)  $\mu\text{m}$  in polar axis, (22.5–)27.1(–31.3)  $\mu\text{m}$  in equatorial diameter, P/E = (0.94–)1.15(–1.28), spheroidal or subprolate in shape, elliptic or rectangular-elliptic in equatorial view, almost circular in polar view. Colpi medium in size, 0.7–0.8 times the length of polar axis, ca. 1  $\mu\text{m}$  wide at equator, tapering to ends, tectate along margin; colpus membrane almost smooth; endoaperture medium in size, 0.1–0.3 times the length of polar axis. Sexine semitectate. Sculpture of mesocolpium reticulate to rugulate, lumina 1–1.5  $\mu\text{m}$  in diameter, with free columellae elements.

Exine ca. 2  $\mu\text{m}$  thick in mesocolpium; sexine thinner than nexine; tectum discontinuous; infratectum well developed, consisting of irregularly branched columellae; foot-layer discontinuous and irregular; endexine very well developed, more than 1/2 times the thickness of exine, gradually thickening toward the colpus.

Voucher specimens: Japan. Honshu. Miyazaki Pref. Takahara-machi, Mts. Kirishima, Koike. 14 Sep. 1980. J. Murata 9998 (TUS).

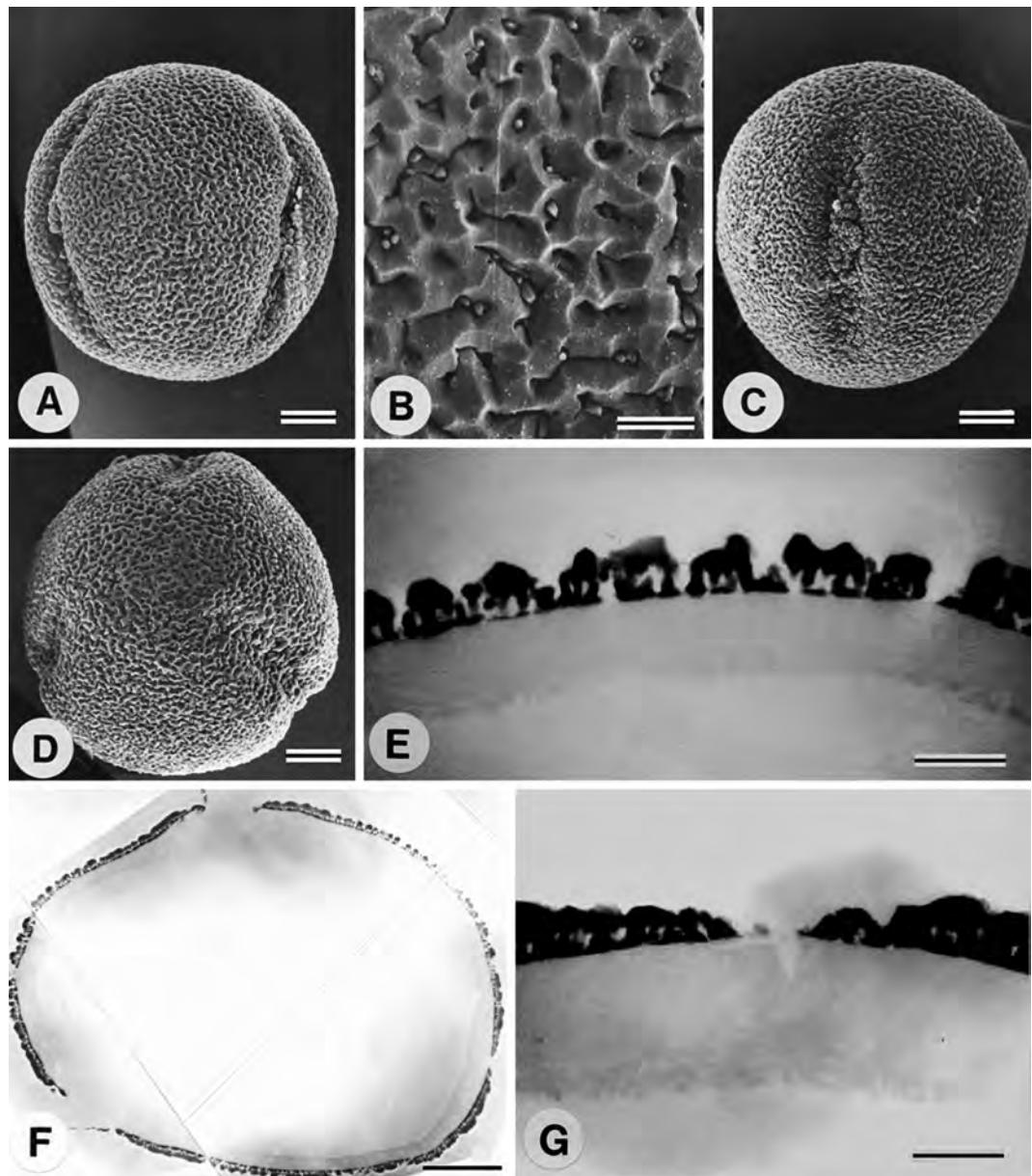


Fig. 4. Pollen of *Hylodesmum nudiflorum* (DC.) H. Ohashi & R. R. Mill. A. Mesocolpium-centered equatorial view. B. Tectum at mesocolpium. C. Aperture-centered equatorial view. D. Polar view. E. Radial section across mesocolpium. F. Mostly radial section of whole grain. G. Section across aperture. Scale bar = 1  $\mu$ m.

#### 6. ***Hylodesmum pauciflorum* (Nutt.) H. Ohashi & R. R. Mill** [Fig. 6]

Pollen grains tricolporate; medium in size, (26.0)–27.5(–29.0)  $\mu$ m in polar axis, (22.5)–

24.6(–26.8)  $\mu$ m in equatorial diameter, P/E = (1.04)–1.12(–1.22), prolate spheroidal or subprolate in shape, elliptic in equatorial view, almost circular in polar view. Colpi

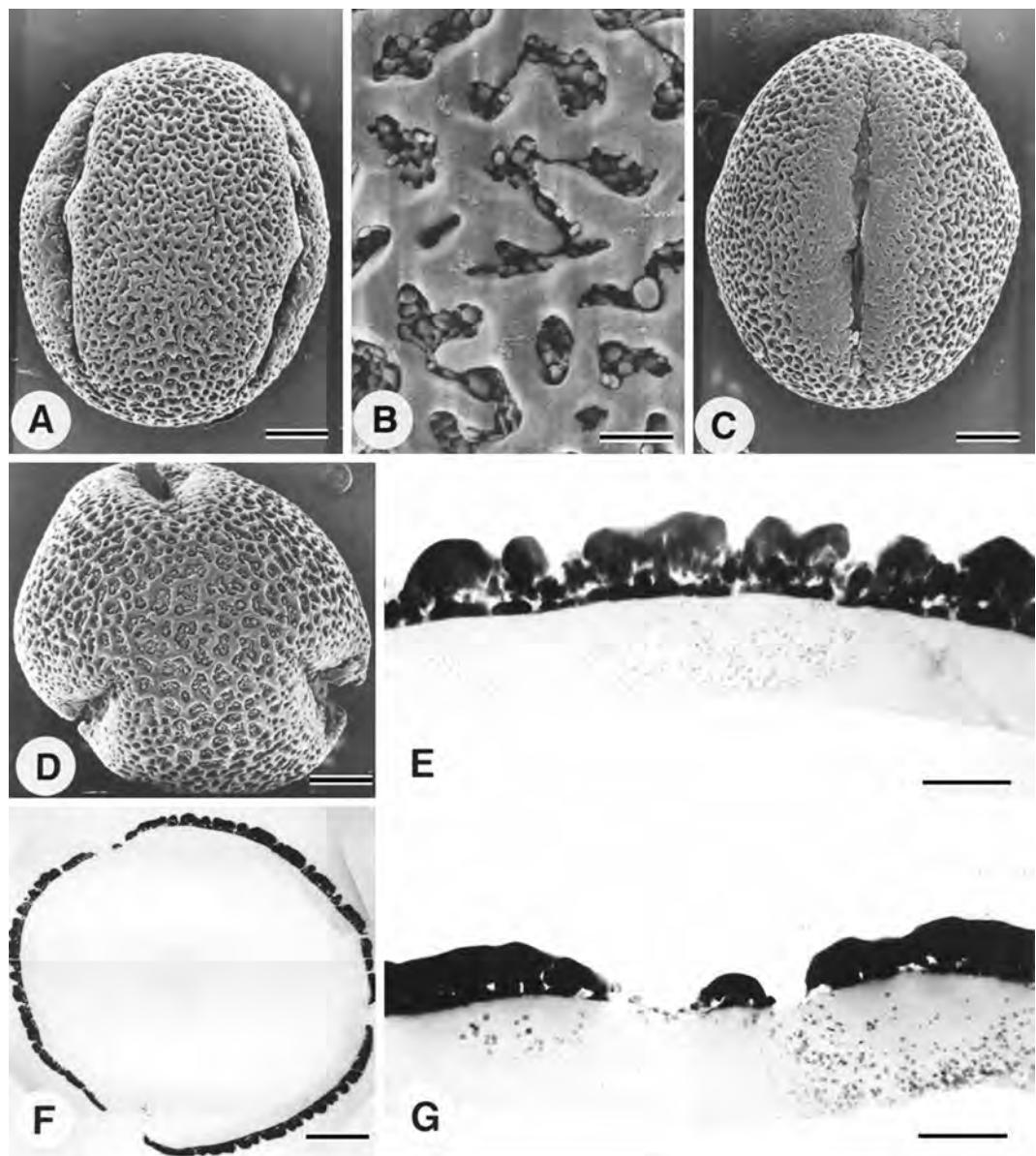


Fig. 5. Pollen of *Hylodesmum oldhamii* (Oliver) H. Ohashi & R. R. Mill. A. Mesocolpium-centered equatorial view. B. Tectum at mesocolpium. C. Aperture-centered equatorial view. D. Polar view. E. Radial section across mesocolpium. F. Mostly radial section of whole grain. G. Section across aperture. Scale bar = 1  $\mu$ m.

short to medium in size, 0.6–0.7 times the length of polar axis, narrow, ca. 2  $\mu$ m wide at equator, tapering slightly to rounded ends, almost undifferentiated from mesocolpium along margin; colpus membrane with

scattered granules; endoaperture medium in size, 0.1–0.3 times the length of polar axis. Sexine tectate. Sculpture of mesocolpium finely rugulate to granulate.

Exine ca. 1–1.5  $\mu$ m thick in mesocolpium,

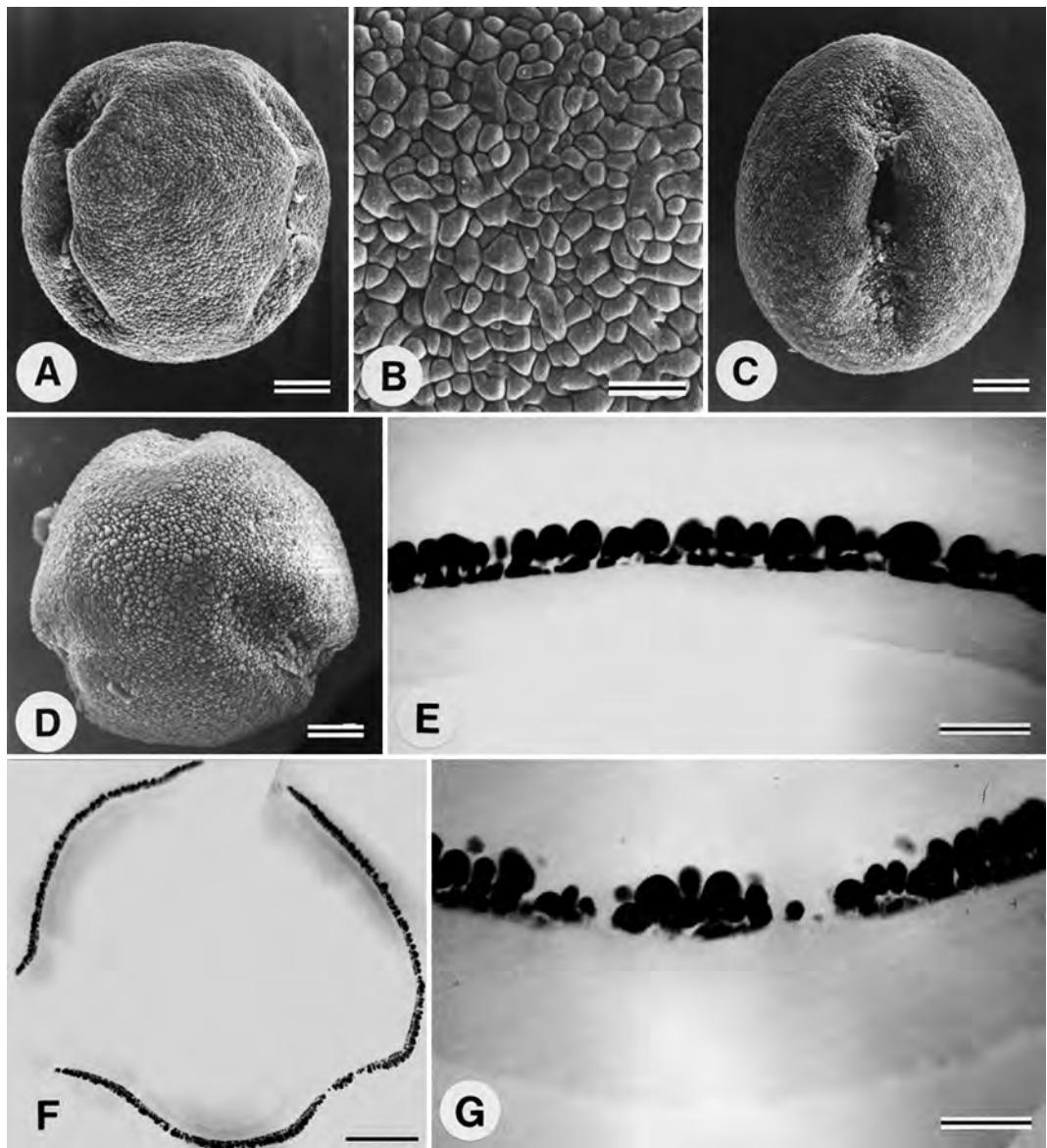


Fig. 6. Pollen of *Hylodesmum pauciflorum* (Nutt.) H. Ohashi & R. R. Mill. A. Mesocolpium-centered equatorial view. B. Tectum at mesocolpium. C. Aperture-centered equatorial view. D. Polar view. E. Radial section across mesocolpium. F. Mostly radial section of whole grain. G. Section across aperture. Scale bar = 1  $\mu$ m.

sexine thinner than nexine; tectum discontinuous, 1/4–1/5 times the thickness of exine; infratectum very short, less than 1/2 times the thickness of tectum, consisting of regular columellae; foot-layer irregular, discontinu-

ous; endexine well developed, more than 1/2 times the thickness of exine, gradually thickening toward the colpus.

Voucher specimens: [origin U.S.A. Missouri. St. Louis Co., Fern Glen. 17 Oct. 1977. White 3004]

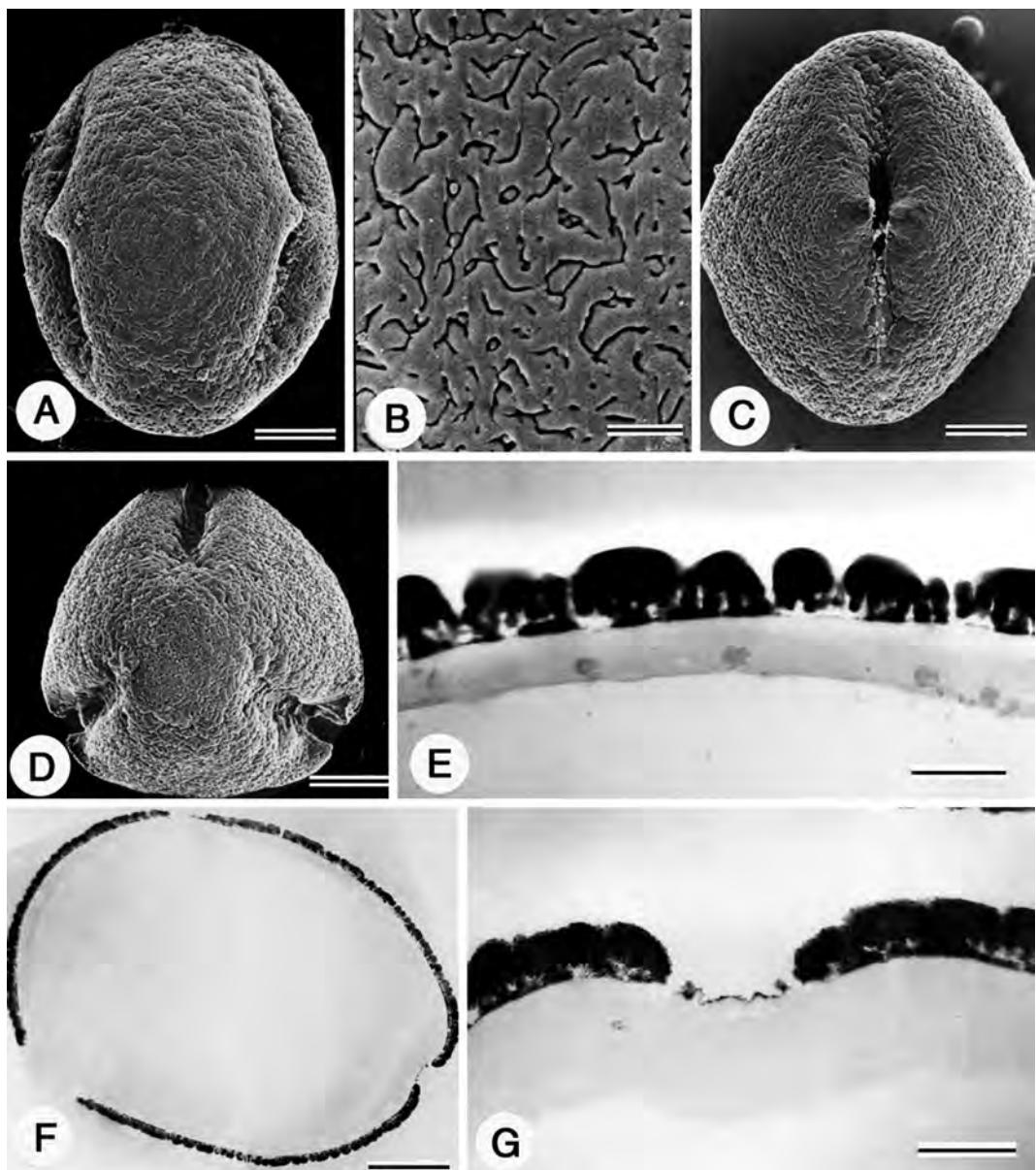


Fig. 7. Pollen of *Hylodesmum podocarpum* (DC.) H. Ohashi & R. R. Mill. A. Mesocolpium-centered equatorial view. B. Tectum at mesocolpium. C. Aperture-centered equatorial view. D. Polar view. E. Radial section across mesocolpium. F. Mostly radial section of whole grain. G. Section across aperture. Scale bar = 1  $\mu$ m.

cultivated in the greenhouse of Tohoku Univ., Sendai. 28 Aug. 1982. Y. Tateishi 10651 (TUS).

7. ***Hylodesmum podocarpum* (DC.) H. Ohashi & R. R. Mill** [Fig. 7]

Pollen grains tricolporate; small to medium in size, (20.5–)25.4(–27.9)  $\mu$ m in

polar axis, (16.2)–19.6(–21.6)  $\mu\text{m}$  in equatorial diameter,  $\text{P/E} = (1.14)–1.30(–1.57)$ , subprolate or prolate in shape, elliptic in equatorial view, almost circular in polar view. Colpi medium to long in size, 0.7–0.8 times the length of polar axis, very narrow, ca. 1  $\mu\text{m}$  wide at equator, tapering slightly to rounded ends, almost undifferentiated from mesocolpium along margin; colpus membrane with fine granules; endoaperture medium in size, 0.1–0.3 times the length of polar axis. Sexine tectate. Sculpture of mesocolpium finely rugulate.

Exine 1–1.5  $\mu\text{m}$  thick in mesocolpium, as thick as or slightly thicker than nexine; tectum discontinuous, 1/3–1/4 times the thickness of exine; infratectum undefined, more than 1/2 times the thickness of tectum, consisting of columellae; foot-layer discontinuous; endexine well developed, ca. 1/2 times the thickness of exine, gradually thickening toward colpi.

Voucher specimens: Japan. Honshu. Yamanashi Pref. Oshino-mura. 21 Aug. 1971. Y. Tateishi 342 (TUS) for SEM examination. Hokkaido. Hiyamashicho, Kamaishi-cho, Orito. 5 Aug. 1987. H. Takahashi 7732 (TUS) for TEM examination.

Note: The voucher specimens cited above are referable to *Hylodesmum podocarpum* subsp. *oxyphyllum* (DC.) H. Ohashi & R.R. Mill var. *mandshuricum* (Maxim.) H. Ohashi & R. R. Mill. Ohashi (1973) showed that the pollen grains of *Hylodesmum podocarpum* vary in shape, size and exine thickness. Grains of var. *mandshuricum* was reported as large as thick as 3  $\mu\text{m}$ .

#### 8. *Hylodesmum repandum* (Vahl) H. Ohashi & R. R. Mill [Fig. 8]

Pollen grains triporate (or tricolporate, rarely tetracolporate), medium to large in size, (26.6)–32.5(–37.5)  $\mu\text{m}$  in polar axis, (31.3)–36.9(–45.9)  $\mu\text{m}$  in equatorial diameter,  $\text{P/E} = (0.71)–0.88(–1.09)$ , oblate, suboblate or spheroidal in shape, elliptic or subcircular in equatorial view, almost

angular in polar view; pore large in size, ca. 0.3–0.5 times the length of polar axis, ca. 7–9  $\mu\text{m}$  wide at equator, margins almost undifferentiated from mesocolpium. Sculpture psilate, microperforate at mesocolpium, irregularly finely rugulate to granulate at apocolpium.

Exine ca. 2  $\mu\text{m}$  thick in mesocolpium, ca. 1.5  $\mu\text{m}$  thick in mesocolpium; sexine about as thick as nexine in mesocolpium, ca. 0.5 times the thickness of nexine on apocolpium; tectum 0.20–0.25 times the thickness of exine, continuous in mesocolpium, discontinuous on apocolpium; infratectum almost as thick as tectum, defined in mesocolpium, consisting of long columellae, undefined on apocolpium, consisting of short columellae; foot-layer reduced and almost absent; endexine very well developed, ca. 1  $\mu\text{m}$  thick.

Voucher specimen: Malaysia. Cameron Highland. M. Togashi 622245 (TI).

#### 9. *Hylodesmum williamsii* (H. Ohashi) H. Ohashi & R. R. Mill [Fig. 9]

Pollen grains tricolporate; medium in size, (24.8)–29.0(–31.0)  $\mu\text{m}$  in polar axis, (22.5)–24.5(–26.3)  $\mu\text{m}$  in equatorial diameter,  $\text{P/E} = (1.05)–1.18(–1.28)$ , prolate spheroidal or subprolate in shape, elliptic in equatorial view, almost circular in polar view. Colpi medium to long, 0.8–0.9 times the length of polar axis, very narrow, ca. 1  $\mu\text{m}$  wide at equator, narrowing slightly to rounded ends, almost undifferentiated from mesocolpium along margin; colpus membrane almost smooth; endoaperture medium in size, 0.1–0.3 times the length of polar axis. Sexine tectate. Sculpture of mesocolpium finely rugulate to microreticulate, lumina less than 1  $\mu\text{m}$  in diameter.

Exine 1–1.5  $\mu\text{m}$  thick in mesocolpium; sexine as thick as or slightly thicker than nexine; tectum almost discontinuous, 1/3–1/2 times the thickness of exine; infratectum undefined, as thick as tectum, consisting of

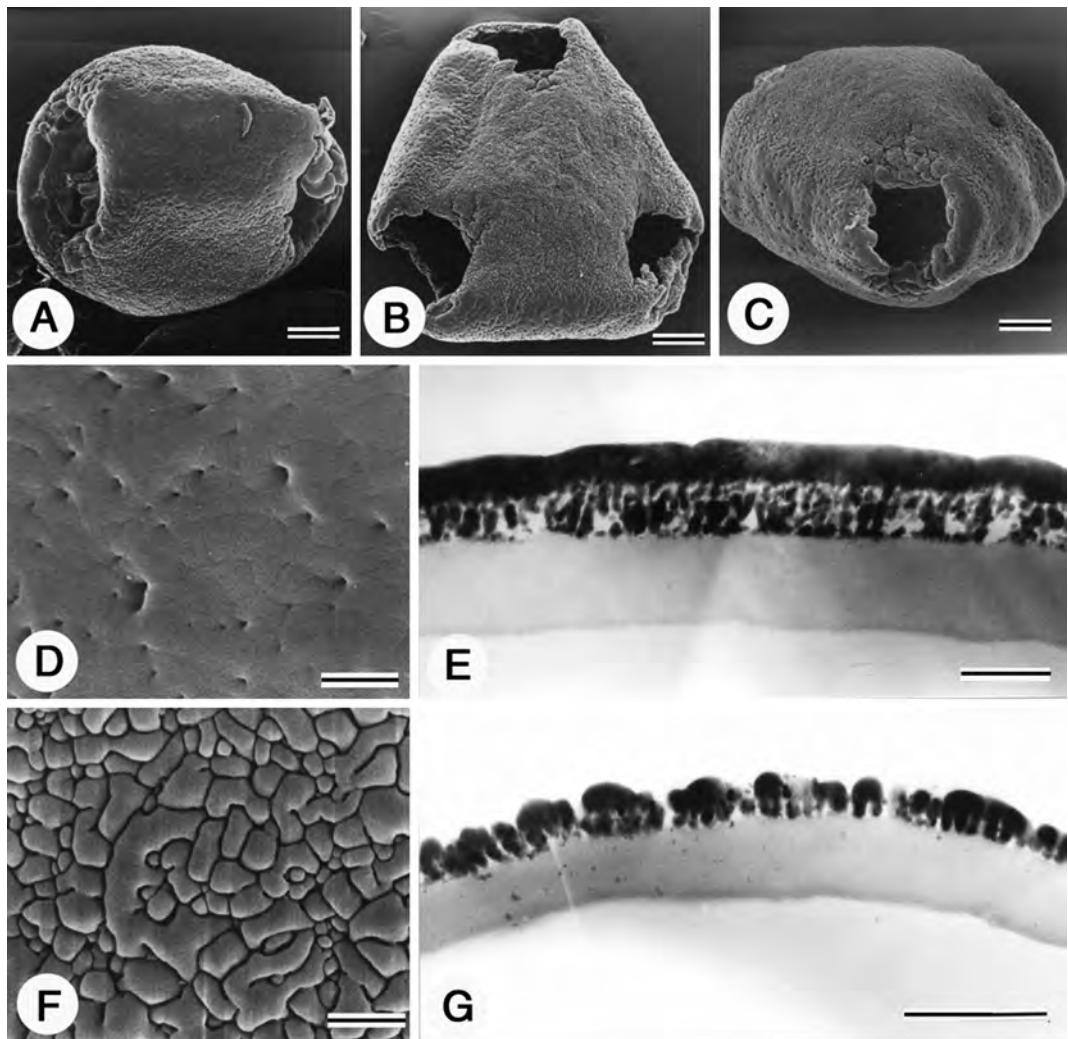


Fig. 8. Pollen of *Hylodesmum repandum* (Vahl) H. Ohashi & R. R. Mill. A. Mesocolpium-centered equatorial view. B. Polar view. C. Aperture-centered equatorial view. D. Tectum at mesocolpium. E. Radial section across mesocolpium. F. Tectum at apocolpium. G. Radial section across apocolpium. Scale bar = 1  $\mu$ m.

columellae; foot-layer discontinuous, irregular; endexine well developed, 1/3–1/2 times the thickness of exine.

Voucher specimens: Nepal. Marsyandi Khola, Dhanagyang (2200 m) – Tal (1620 m). 7 Aug. 1983. H. Ohba & al. 8350905 (TUS); China. Yunnan. X. B. Zhen & al. 6570 (KUN).

#### Pollen diversity in genus *Hylodesmum*

Pollen grains of nine species in the genus *Hylodesmum* were examined in this study. The commonest features of pollen grains of these species are mostly tricolporate, prolate spheroidal to subprolate, fine-rugulate to microreticulate exine, with the endexine thicker than the tectum with the infratectum and the foot layer, the densely columellate

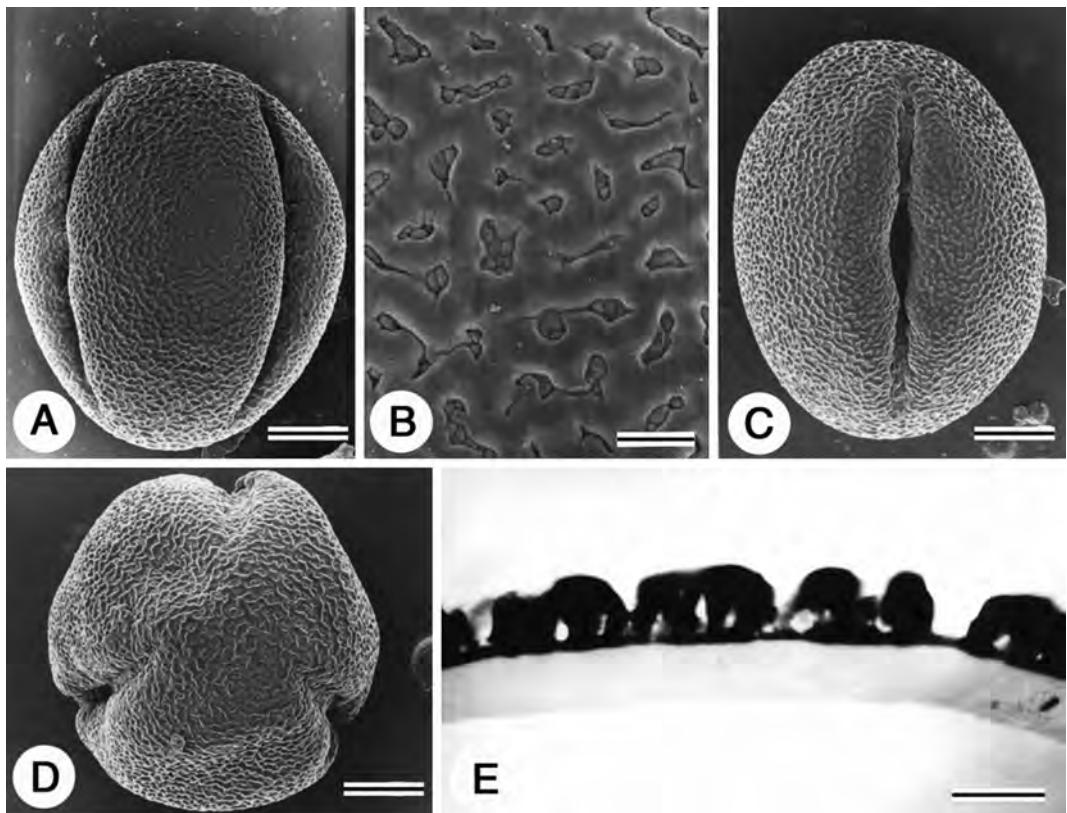


Fig. 9. Pollen of *Hylodesmum williamsii* (H. Ohashi) H. Ohashi & R. R. Mill. A. Mesocolpium-centered equatorial view. B. Polar view. C. Aperture-centered equatorial view. D. Tectum at mesocolpium. E. Radial section across mesocolpium. Scale bar = 1  $\mu$ m.

infratectum and the discontinuous foot layer. From these features, however, *H. oldhamii* differs in the exine sculptures and structures and *H. repandum* in the pollen types and shapes. Ohashi (1973) recognized *D. podocarpum*-type, *D. oldhamii*-type and *D. repandum*-type based on the difference in pollen types, shapes and sculpture patterns. The commonest pattern is corresponding to the *D. podocarpum*-type, while each of the latter two agree with the *D. oldhamii*-type and *D. repandum*-type, respectively. It become clear that the *D. repandum*-type shares common structure of the exine with the *D. podocarpum*-type, while the *D. oldhamii*-type differs from both types in the structure.

The pollen of *Hylodesmum oldhamii* has clear reticulate or rugulate sculpture of which the lumina of reticulation often change to irregular shape and size by fusing with neighbouring ones (Figs. 5A–D). Also, its exine structure is characteristic in having infratectum consisting of irregularly branched dense columellae and thicker endexine (Figs. 5E–G).

Ohashi (1973) reported the pollen of *Desmodium repandum* as tricolporate, rarely tetracolporate, and the grains are often seemingly triporate or tetraporate in having very obscure colpi. We could not confirm colpi in our samples in this study. Also, we could not find tetracolporate grains reported by Ohashi

(1973). Such differences in results may reflect a lack of sampling. We took pollen grains from the one sample from Malaysia, Togashi 622245 (TI), a specimen among those used by Ohashi (1973) who used several others from Thailand and Borneo in Southeast Asia and Uganda in central east Africa.

The pollen of *Hylodesmum repandum* differs from others in pollen shape, sculpture pattern and exine thickness. It is apparently more depressed than those of others (Figs. 8A, C) and the sculpture and structure are both different between at mesocolpium and polar area. The sculpture is psilate with microperforations (Figs. 8B, D) and the infratectum is composed of dense slender longer columellae at the mesocolpium (Fig. 8E), while the sculpture is irregularly finely rugulate to granulate (Fig. 8F) and the infratectum is composed of commonly seen columellae similar to those of other *Hylodesmum* species except *H. oldhamii* at the apocolpium (Fig. 8G).

Pollen grains of the North American species, *Hylodesmum glutinosum*, *H. nudiflorum* and *H. pauciflorum*, are basically the same as the Asiatic species except *H. oldhamii* and *H. repandum*. *Hylodesmum pauciflorum* shows, however, somewhat different variation in sculpture pattern that is finely rugulate to granulate (Figs. 6B, E). This may be related to its characteristic white flowers in contrast with rose to pale purple or orange to red flowers in other species among the genus.

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葉 繢, 大橋広好: マメ科ヌスピトハギ属の花粉形態

ヌスピトハギとその近縁種は多くの形態的な特徴によって典型的な *Desmodium* と異なることが

明らかにされ, 分子系統上も単系統であり (Kajita and Ohashi 1994), 別属として扱われる (Ohashi

and Mill 2000, Ohashi 2006). ヌスピトハギ属の学名は *Hylodesmum* と命名され, *Desmodium* はシバハギ属と改名された (大橋 2002. 本誌 77: 59–60).

ヌスピトハギ属には14種が含まれている。この属の花粉形態は幾瀬 (1956) の報告に始まり, Ohashi (1973) の研究で大部分の種について明らかにされた。しかし、これらは主に光学顕微鏡による観察であったため微細形態と構造は十分には明らかにされなかった。Chen and Huang (1993) は台湾の *D. laxum* subsp. *leptopus* と subsp. *laterale* (= *H. leptopus*, *H. laterale*) の花粉を電子顕微鏡で観察したが、1種だけであったためヌスピトハギ類としての特徴を見いだせなかった。本研究ではヌスピトハギ属の独立性を支持する証拠の一つとして、花粉特性を明らかにするために、9種 (アジア産5種、アメリカ産3種、アジア・アフリカ産1種) の花粉の微細形態と内部構造を走査型および透過型電子顕微鏡を用いて調べた。

ヌスピトハギ属の花粉は外壁に特徴があり、内層が厚く、柱状層が密で、底部層が不連続である。

フジカンゾウ *H. oldhamii* と *H. repandum* (アジア・アフリカに分布) を除く他の7種には共通の花粉形態と微細構造が見られた。北アメリカに隔離分布する3種もアジア産種と基本的に一致している。これらの花粉特徴は3溝孔型、長球状球形から亜長球形、表面模様が微小網目型と細しわ模様である。しかし、フジカンゾウでは表面模様は網目型からしわ模様型で、網目が癒合して不規則なしわとなる。層構造は柱状層が分岐した不規則な小柱で構成される。この構造はヌスピトハギ連の中では他に知られていない。また、*H. repandum* の花粉は溝がほとんど発達せず、3孔型と思われる。ただし、Ohashi (1973) は *H. repandum* の花粉は3孔型あるいは4孔型に見えるが3溝孔型あるいは4溝孔型であるとした。ヌスピトハギ属の他の種では3溝孔型である。また、*H. repandum* の花粉の形は亜偏球形で、ヌスピトハギ属の他の種と異なっている。

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